

What is claimed is:

1. A plant comprising transformed plant cells, said transformed plant cells comprising a heterologous nucleic acid construct encoding a mutant AL1 protein, wherein said heterologous nucleic acid construct comprises a nucleotide sequence selected from the group consisting of SEQ ID NO:40 (K144), SEQ ID NO:41 (E145), SEQ ID NO:42 (E146), SEQ ID NO:43 (EE146), SEQ ID NO:44 (A147Y), SEQ ID NO:45 (L148), SEQ ID NO:46 (L148V), SEQ ID NO:47 (L148V\*), SEQ ID NO:48 (L148G), SEQ ID NO:106 (L145A), and SEQ ID NO:49 (II151) or any combination thereof.
2. The plant of claim 1, wherein said plant has increased tolerance or resistance to infection by a geminivirus as compared to a plant lacking said heterologous nucleic acid construct.
3. The plant of claim 2, wherein said plant has increased tolerance or resistance to infection by a geminivirus selected from the group consisting of tomato golden mosaic virus, tomato mottle virus, tomato yellow leaf curl virus, tomato leaf curl virus, African cassava mosaic virus, Indian cassava mosaic virus, potato yellow mosaic virus, bean golden mosaic virus, bean dwarf mosaic virus, squash leaf curl virus, Texas pepper virus, cotton leaf curl virus and beet curly top virus.
4. The plant of claim 1, further comprising a nucleotide sequence selected from the group consisting of SEQ ID NO:28 (Ala1), SEQ ID NO:32 (Ala5), SEQ ID NO:33 (Ala6), SEQ ID NO:34 (Ala7), SEQ ID NO:36 (Ala9), SEQ ID NO:26 (Ala13), SEQ ID NO:38 (Leu), SEQ ID NO:29 (Ala2), SEQ ID NO:30 (Ala3), SEQ ID NO:31 (Ala4), SEQ ID NO:39 (Ala4+5), SEQ ID NO:27 (Ala14), SEQ ID NO:35 (Ala8), and SEQ ID NO:37 (Ala10) or any combination thereof.
5. A plant according to claim 1, wherein said plant is selected from the group consisting of tomato, cassava, potato, bean, squash and beet.
6. A plant according to claim 1, wherein said plant is of the family Solanaceae.

7. A plant according to claim 1, wherein said plant is a tomato plant and has increased resistance or tolerance to infection by tomato golden mosaic virus (TGMV).

8. A method of combating geminivirus infection in an agricultural field, comprising planting the field with a crop of plants according to claim 1.

9. A method of making the transgenic plant of claim 1, comprising:

a) transforming a cell of a plant with a heterologous nucleic acid construct encoding a mutant AL1 protein, wherein said heterologous nucleic acid construct comprises a nucleotide sequence selected from the group consisting of SEQ ID NO:40 (K144), SEQ ID NO:41 (E145), SEQ ID NO:42 (E146), SEQ ID NO:43 (EE146), SEQ ID NO:44 (A147Y), SEQ ID NO:45 (L148), SEQ ID NO:46 (L148V), SEQ ID NO:47 (L148V\*), SEQ ID NO:48 (L148G) SEQ ID NO:106 (L145A), and SEQ ID NO:49 (II151) or any combination thereof; and

b) regenerating the transgenic plant from said transformed plant cell.

10. The method of claim 9, wherein the heterologous nucleic acid construct further comprises a nucleotide sequence selected from the group consisting of SEQ ID NO:28 (Ala1), SEQ ID NO:32 (Ala5), SEQ ID NO:33 (Ala6), SEQ ID NO:34 (Ala7), SEQ ID NO:36 (Ala9), SEQ ID NO:26 (Ala13), SEQ ID NO:38 (Leu), SEQ ID NO:29 (Ala2), SEQ ID NO:30 (Ala3), SEQ ID NO:31 (Ala4), SEQ ID NO:39 (Ala4+5), SEQ ID NO:27 (Ala14), SEQ ID NO:35 (Ala8), and SEQ ID NO:37 (Ala10) or any combination thereof.

11. An isolated nucleic acid comprising a nucleotide sequence encoding a mutant AL1 protein, wherein said nucleotide sequence is selected from the group consisting of SEQ ID NO:40 (K144), SEQ ID NO:41 (E145), SEQ ID NO:42 (E146), SEQ ID NO:43 (EE146), SEQ ID NO:44 (A147Y), SEQ ID NO:45 (L148), SEQ ID NO:46 (L148V), SEQ ID NO:47 (L148V\*), SEQ ID NO:48 (L148G) SEQ ID NO:106 (L145A), and SEQ ID NO:49 (II151) or any combination thereof

12. The nucleic acid construct of claim 1, further comprising a nucleotide sequence selected from the group consisting of SEQ ID NO:28 (Ala1), SEQ ID NO:32 (Ala5), SEQ ID NO:33 (Ala6), SEQ ID NO:34 (Ala7), SEQ ID NO:36 (Ala9), SEQ ID NO:26 (Ala13), SEQ ID NO:38 (Leu), SEQ ID NO:29 (Ala2), SEQ ID NO:30 (Ala3), SEQ ID NO:31 (Ala4), SEQ

ID NO:39 (Ala4+5), SEQ ID NO:27 (Ala14), SEQ ID NO:35 (Ala8), and SEQ ID NO:37 (Ala10) or any combination thereof.

13. A vector comprising the nucleic acid construct of claim 11.
14. A vector comprising the nucleic acid construct of claim 12.
15. A cell comprising the vector of claim 13.
16. A cell comprising the vector of claim 14.
17. Seed or progeny of the plant of claim 1, which seed or progeny comprises said nucleic acid construct.
18. Seed or progeny of the plant of claim 4, which seed or progeny comprises said nucleic acid construct.
19. A mutant AL1 protein comprising an amino acid sequence selected from the group consisting of SEQ ID NO:17 (K144), SEQ ID NO:18 (E145), SEQ ID NO:19 (E146), SEQ ID NO:20 (EE146), SEQ ID NO:21 (A147Y), SEQ ID NO:22 (L148), SEQ ID NO:23 (L148V), SEQ ID NO:24 (L148G), SEQ ID NO:109 (L145A), SEQ ID NO:25 (I151), SEQ ID NO:3 (Ala1), SEQ ID NO:15 (Ala5), SEQ ID NO:5 (Ala6), SEQ ID NO:6 (Ala7), SEQ ID NO:8 (Ala9), SEQ ID NO:9 (Ala13), SEQ ID NO:11 (Leu), SEQ ID NO:12 (Ala2), SEQ ID NO:13 (Ala3), SEQ ID NO:14 (Ala4), SEQ ID NO:4 (Ala4+5), SEQ ID NO:10 (Ala14), SEQ ID NO:7 (Ala8), and SEQ ID NO:16 (Ala10).
20. An isolated nucleic acid encoding the protein of claim 19.